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CHEMICAL, MILLING, AND BAKING EXPERIMENTS
WITH HARD RED SPRING WHEATS, 1939

By

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and J. A. Clark, senior agronomist, Wheat
Investigations, Division of Cereal Crops
and Diseases, Bureau of Plant Industry

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INTRODUCTION

Some samples of the varieties and new hybrid strains of wheat grown in cooperative experiments in the spring wheat region of the United States are milled each year by the U. S. Department of Agriculture and the flour baked into bread by a number of different methods to determine their quality. The purpose of this report is to make available all of the 1939 data obtained for these varieties and strains of hard red spring wheat tested from plots and nursery experiments.

Some of the data have previously been reported^{2/}. The experiments were conducted in the Milling, Baking, and Chemical Laboratory of the Grain and Seed Division, Agricultural Marketing Service.

^{1/} Cooperative investigations of the Division of Cereal Crops and Diseases, Bureau of Plant Industry, and the Grain and Seed Division, Agricultural Marketing Service. Credit is due H. C. Fellows, J. F. Hayes, Elwood Hoffercker, Ray Weaver, and B.E. Rothgeb of the Milling, Baking, and Chemical Laboratory, Grain and Seed Division, Agricultural Marketing Service, for making some of the determinations reported in this study, and to A. Sallak for assistance in calculating and tabulating some of the data.

^{2/} Clark, J. A. Results of spring wheat varieties grown in cooperative plot and nursery experiments in the spring wheat region in 1939, with averages for 1929 to 1939. U. S. Dept. Agr., Bur. Plant Indus., Div. Cereal Crops and Diseases [Unnumb. Pub.] 42 pp. Jan. 10, 1940. [Mimeographed.]

SOURCE OF SAMPLES

Chemical, milling, and baking tests have been made and reported on eastern and western composite samples of the uniform varieties grown in plots and from Uniform Regional Nurseries. Two other composites also were made: (1) plot samples from four North Dakota stations and (2) plot samples from four Minnesota stations. In addition station samples grown in plots at Fargo, Langdon, Mandan, and Dickinson, N. Dak., Brookings, S. Dak., some new strains increased at Bozeman, Mont., and a few wheats from grow nursery tests at Mandan, N. Dak., were tested. In all, 180 samples have been milled and baked from the 1939 crop and the quality data are here recorded.

METHODS USED IN THE BAKING TESTS

Baking tests on the 1939 samples were conducted by four methods in order to obtain more information with respect to baking quality of the new varieties. The four baking procedures, (No. 1) basic, (No. 2) commercial, (No. 3) commercial-bromate, and (No. 6) commercial-bromate-malted wheat flour were used for all samples. The No. 6 method was substituted for the No. 4, malt-phosphate-bromate method used for the 1938 crops. In testing the eastern and western composite samples of the uniform varieties grown in plots; the No. 4 method was used but because of the poor results for crumb color and grain-texture, the method was discontinued in favor of No. 6. This latter method gives essentially the same volumes but much better scores for color and texture. Details of the four methods used this year with the various ingredients are shown in table 1.

Table 1. - Baking methods used for samples of the 1939 crop

Ingredients	Baking method			
	1	2	3	6
	Basic	Commercial	Commercial bromate	Commercial bromate-malted wheat flour
Flour (grams)	100	100	100	100
Yeast (grams)	2.0	2.0	2.0	2.0
Salt (grams)	1.5	1.5	1.5	1.5
Sugar (grams)	5.0	5.0	5.0	5.0
Potassium bromate (grams)			.001	.001
Malted wheat flour (grams)				.2
Dried skim milk (grams)		4.0	4.0	4.0
Shortening (grams)		3.0	3.0	3.0
Water absorption (percent)	proper	proper	proper	proper
Mixing time (minutes)	2	2	2	2
Fermentation time	180	180	180	180
Fermentation periods				
1st punch after 105 minutes				
2nd punch after additional 50 minutes				
Mold after additional 25 minutes				
Proofing time 55 minutes				
Baked 25 minutes at 230° C.				

It should be pointed out that the basic method (No. 1) has been used on all samples starting with the 1929 crop. In 1935, the commercial method (No. 2) was added and in 1936 the commercial-bromate (No. 3). For a part of the samples of the 1937 and all of the 1939 crop the malt-phosphate-bromate (No. 4) method was used. For a part of the 1938 and for all of the 1939 crops the No. 6 method has been used. This latter method seems to reveal the maximum strength of the wheats and generally shows the greatest range. The newer baking formula seems to make provision for adequate gas production by the employment of sufficient sugar and diastatic supplements. In a number of tests additional amounts of potassium bromate did not seem to assist in further development of the gluten.

In the following tables the four different methods of baking are reported for loaf volume but only average figures for absorption as well as weight, color, and texture of loaf are shown. The varieties are ranked in order of their average volumes for the different methods. The highest ranking variety with respect to each property is indicated by underlining. Standard errors have been calculated (Interaction: baking method x variety) and a double underline is drawn in each table separating those varieties which are significantly lower than the wheat having the highest average volume in the test.

EXPERIMENTAL RESULTS

The results for the composite samples and stations are given in tables 2-13. These tables are largely self-explanatory, except for a few pertinent remarks which should be noted to explain some of the results obtained. Acre yields are included where comparable to assist in interpretation of results.

The test weights for most of the composite and station samples were satisfactory. Stem rust was not a factor at most stations, and mostly resistant varieties were tested. The eastern composite plot samples varied from 55.0 pounds for Marquis to 58.7 pounds for Premier. The lower test weight of Marquis is attributable to both stem and leaf rust.

The wheat protein contents for the most part were uniformly high except for Mandan which averaged only 12.0 percent. The Brookings, S. Dak., samples averaged highest in protein and in baking resembled more samples of the 1938 crop.

Table 2. - Milling and baking results obtained on some of the Hard Red spring wheat varieties grown in plots at Fargo, N. Dak., in 1939

Variety or cross	Nursery number	C.I. number	Acre yield	Test weight	Protein content		Flour		Water absorption, average	Baking method and volume of loaf					Weight of loaf average	Crumb color average	Grain texture average
					Wheat	Flour	Yield	Ash		No.1	No.2	No.3	No.6	Average			
			(Bu.)	(Lbs.)	(Pct.)	(Pct.)	(Pct.)	(Pct.)	(Pct.)	(Cc)	(Cc)	(Cc)	(Cc)	(Cc)	(Grams)	(Score)	(Score)
Pilot-13	1098-13	11945	29.2	57.2	14.4	13.5	70.7	.53	63.0	752	874	939	936	875	147	88.8	90.0
Thatcher	-----	10003	22.3	57.6	15.2	14.9	71.7	.47	63.0	741	792	931	934	850	146	86.3	91.3
Pilot (B)	1098-B	11428	28.8	57.7	14.8	13.9	70.8	.50	63.0	700	844	888	957	847	147	92.5	92.5
Regent	R.L.975	11869	23.3	55.2	15.9	15.4	70.8	.54	65.0	651	803	879	936	817	150	81.3	81.3
Rival	Ns.2634	11708	26.8	58.5	14.4	14.1	73.3	.53	65.0	675	809	864	891	810	148	87.5	88.8
C.-D.C. x C.H.F. ^{1/}	Ns.2816	12030	26.0	58.0	14.7	14.4	71.4	.57	66.0	629	764	847	905	786	150	90.0	90.0
Vesta	Ns.2592	11712	25.4	59.0	14.7	14.3	73.3	.52	63.0	640	758	838	905	785	149	87.5	83.8
Merit	1348	11870	27.2	57.2	14.4	14.0	71.7	.54	67.0	635	758	847	896	784	151	81.3	85.0
C.-D.C. x C.H.F. ^{1/}	Ns.2746	11894	28.5	59.8	14.9	14.0	73.1	.54	68.0	671	787	832	841	783	152	88.8	88.8
Mercury	Ns.2740	11872	25.4	58.1	14.3	13.7	73.0	.54	69.0	683	752	823	871	782	153	87.5	85.0
H-44 x Ceres	1344	11883	27.7	58.8	13.8	13.1	71.2	.55	69.0	643	767	821	873	776	153	78.8	87.5
Carleeds	-----	11301	24.0	55.8	14.2	13.4	73.5	.47	63.0	632	746	823	897	775	150	88.8	88.8
C.-D.C. x C.H.F. ^{1/}	Ns.2742	11939	27.6	60.2	14.2	13.6	72.8	.49	65.0	683	772	809	826	773	150	93.8	90.0
Premier	Ns.2772	11940	26.5	60.0	14.2	13.8	73.0	.54	70.0	617	737	832	867	763	154	81.3	81.3
C.-D.C. x C.H.F. ^{1/}	Ns.2744	11941	28.5	58.6	13.8	13.3	72.9	.54	68.0	658	761	772	821	753	151	88.8	86.3
C.-D.C. x C.H.F. ^{1/}	Ns.2797	12005	27.1	56.7	13.8	13.3	73.9	.50	65.5	641	763	770	822	749	150	88.8	86.3
Average			26.8	58.0	14.5	13.9	72.3	.52	65.8	666	780	845	886	794	150	87.0	87.3
Range			5.2	5.0	2.0	2.6	3.2	.10	4.0	135	137	169	136	126	7	8.2	11.2
Standard error = 25 cc.																	

^{1/} Ceres-Double Cross x Ceres-Hope-Florence.

Table 3. - Milling and baking results obtained on some of the Hard Red spring wheat varieties grown in plots at Langdon, N. Dak., in 1939

Variety or cross	Nursery number	C.I. number	Acre yield	Test weight	Protein content		Flour		Water absorption, average	Baking method and volume of loaf					Weight of loaf average	Crumb color average	Grain texture average
					Wheat	Flour	Yield	Ash		No.1	No.2	No.3	No.5	Average			
			(Bu.)	(Lbs.)	(Pct.)	(Pct.)	(Pct.)	(Pct.)	(Pct.)	(Cc)	(Cc)	(Cc)	(Cc)	(Cc)	(Grams)	(Score)	(Score)
Thatcher	-----	10003	9.5	55.5	16.5	15.9	71.3	.51	65.5	706	792	931	997	857	151	83.7	86.3
Carleods	-----	11301	9.4	55.3	16.0	15.5	72.8	.50	63.0	691	806	905	956	840	149	87.5	88.3
Pilot-13	1090-13	11945	5.9	55.1	16.0	15.0	68.8	.51	63.0	677	818	914	925	834	149	82.5	87.5
Rival	Ns.2634	11708	6.6	57.0	15.7	15.1	71.7	.53	63.0	666	749	888	939	811	149	81.3	87.5
Pilot (B)	1098-B	11428	6.6	56.3	15.8	15.4	70.7	.52	63.0	626	744	896	939	801	150	78.8	86.3
Ceres	-----	6900	7.4	56.0	15.6	14.8	71.6	.53	63.0	654	784	865	894	799	149	85.0	88.8
Vesta	Ns.2592	11712	7.8	56.8	16.0	15.7	71.8	.54	61.0	646	756	841	870	773	150	80.0	85.0
Premier	Ns.2772	11940	11.0	58.9	16.0	15.5	73.0	.55	69.0	617	724	832	900	766	156	80.0	80.0
C.-D.C. x C.H.F. ^{1/}	Ns.2746	11894	10.1	57.8	15.5	14.5	73.1	.57	61.0	643	732	826	823	756	150	81.3	83.8
Merit	1348	11870	8.7	55.4	15.8	14.8	71.0	.54	69.0	602	724	806	888	755	156	76.3	80.0
H-44 x Ceres	1344	11883	7.3	55.7	15.3	14.2	69.8	.60	66.0	602	730	809	879	755	152	72.5	80.0
C.-D.C. x C.H.F. ^{1/}	Ns.2742	11939	10.5	58.9	15.5	14.5	72.4	.45	61.0	641	740	815	815	754	149	83.7	86.3
Mercury	Ns.2740	11872	7.1	56.6	15.1	14.5	72.5	.57	68.0	605	712	789	862	742	155	80.0	76.3
Average			8.3	56.6	15.8	15.0	71.6	.53	64.3	644	755	855	899	788	151	81.0	84.4
Range			5.1	3.8	1.4	1.7	4.3	.15	8.0	104	106	142	182	115	7	15.0	12.5

Standard error = 16 sc.

^{1/} Ceres-Double Cross x Ceres-Hope-Florence.

Table 4. -- Milling and baking results obtained on some of the Hard Red spring wheat varieties grown in plots at Mandan, N. Dak., in 1939

Variety or cross	Nursery number	C.I. number	Acre yield	Test weight	Protein content		Flour		Water absorption, average	Baking method and volume of loaf					Weight of loaf average	Crumb color average	Grain texture average
					Wheat	Flour	Yield	Ash		No.1	No.2	No.3	No.6	Average			
			(Bu.)	(Lbs.)	(Pct.)	(Pct.)	(Pct.)	(Pct.)	(Pct.)	(Cc)	(Cc)	(Cc)	(Cc)	(Cc)	(Grams)	(Score)	(Score)
Thatchor	-----	10003	19.4	59.2	<u>13.9</u>	<u>13.6</u>	69.4	.52	65.0	<u>602</u>	<u>743</u>	<u>767</u>	<u>749</u>	<u>715</u>	151	86.2	<u>87.5</u>
Pilot-13	1098-13	11945	19.7	60.0	11.5	11.3	71.3	<u>.45</u>	63.0	523	703	729	709	666	151	<u>88.8</u>	86.3
Pilot (B)	1098-B	11428	19.3	58.7	12.4	11.7	70.1	.51	63.0	523	677	715	697	653	151	80.0	82.5
Carleeds	----	11801	16.0	57.1	12.0	11.7	<u>73.7</u>	.48	65.0	495	635	697	703	633	152	83.7	82.5
Hope x Hard Federation	1268	11798	<u>21.6</u>	58.6	12.3	11.7	71.5	.50	63.0	486	614	691	703	624	152	76.2	80.0
Rival	Ns.2634	11708	18.7	59.3	11.7	11.2	73.5	.55	63.0	489	660	635	663	612	152	77.5	82.5
Mercury	Ns.2740	11872	19.4	59.5	12.1	11.8	72.9	.54	67.0	492	614	660	674	610	156	78.7	81.3
C.-D.C. x C.-H.-F. ^{1/}	Ns.2744	11941	19.9	59.8	12.5	12.0	71.6	.54	67.0	459	641	666	660	609	155	76.2	78.8
Merit	1348	11870	19.6	59.5	11.5	11.0	72.2	.53	68.0	495	626	672	635	607	157	77.5	77.5
Premier	Ns.2772	11940	18.9	61.7	11.4	10.9	72.6	.53	<u>69.5</u>	490	611	640	646	594	<u>159</u>	77.5	77.5
C.-D.C. x C.-H.-F. ^{1/}	Ns.2742	11939	20.0	<u>61.9</u>	11.7	11.2	73.2	.48	65.0	463	641	620	596	580	154	85.0	80.0
C.-D.C. x C.-H.-F. ^{1/}	Ns.2746	11894	19.5	60.8	12.2	11.5	72.7	.50	63.0	449	629	602	605	571	152	78.8	75.0
Vesta	Ns.2592	11712	20.4	61.3	11.5	11.2	73.2	<u>.45</u>	63.0	463	587	617	581	562	152	78.7	72.5
N. No. 1344	1344	11883	19.4	61.6	11.6	11.3	71.5	.54	66.0	458	635	581	567	560	155	75.0	70.0
Average			19.4	59.9	12.0	11.6	72.1	.51	65.0	492	644	664	656	614	154	80.0	79.6
Range			5.6	4.8	2.5	2.7	4.3	.10	6.5	153	156	186	182	155	8	13.8	17.5

Standard error = 16 cc.

^{1/} Ceres x Double Cross x Ceres-Hope-Florence.

Table 5. - Milling and baking results obtained on some of the Hard Red spring wheat varieties grown in plots at Dickinson, N. Dak., in 1939

Variety or cross	Nursery number	C.I. number	Acres yield	Test weight	Protein content		Flour		Water absorption, average	Baking method and volume of loaf					Weight of loaf average	Crumb color average	Grain texture average
					Wheat	Flour	Yield	Ash		No.1	No.2	No.3	No.6	Average			
			(Bu.)	(Lbs.)	(Pct.)	(Pct.)	(Pct.)	(Pct.)	(Pct.)	(Cc)	(Cc)	(Cc)	(Cc)	(Cc)	(Grams)	(Score)	(Score)
Thatcher	----	10003	26.8	58.7	14.3	13.6	71.1	.40	63.0	660	772	841	844	779	147	87.5	88.8
Pilot (B)	1098-B	11428	26.1	57.4	14.0	13.0	68.9	.40	63.0	641	772	772	820	751	148	87.5	88.8
Carleeds	----	11801	25.8	56.8	13.3	12.8	73.1	.42	63.0	620	761	775	798	739	149	87.5	87.5
Hival	Ns.2634	11708	25.6	57.8	13.8	13.0	73.1	.43	65.0	599	738	775	829	735	148	85.0	85.0
Renown (New)	R.L.716.6	11947	21.5	60.1	14.0	13.2	71.7	.44	63.0	568	718	784	829	725	149	82.5	85.0
Mercury	Ns.2740	11872	27.3	57.5	13.5	12.6	72.7	.46	66.0	620	747	746	781	724	151	86.2	86.3
Pilot-13	1098-13	11945	27.5	58.3	13.0	12.0	70.2	.39	63.0	617	737	752	778	721	148	88.8	88.8
Renown (Old)	R.L.716	11635	22.2	59.8	13.5	12.2	72.1	.41	63.0	550	697	795	804	712	150	80.0	77.5
Vesta	Ns.2592	11712	26.0	59.5	14.1	13.1	72.6	.41	63.0	596	733	738	730	699	148	85.0	83.8
N.No.1131 x Pilot	1441	11948	23.2	58.7	13.6	12.7	69.4	.36	65.0	550	729	732	761	693	149	83.8	81.3
Merit	1348	11870	26.8	57.4	13.4	12.8	71.8	.43	67.0	550	700	724	775	687	153	82.5	80.0
Premier	Ns.2772	11940	28.1	60.5	13.0	11.8	72.0	.41	67.0	515	672	672	724	646	153	82.5	82.5
C.-D.C. x C.-H.-F. ^{1/}	Ns.2742	11939	29.3	60.9	12.9	12.5	72.3	.34	61.0	547	674	672	677	642	149	86.3	83.8
H-44 x Ceres	1344	11883	27.2	59.0	12.5	11.9	70.2	.47	65.0	517	688	657	700	641	151	78.8	76.3
Comet x N.No.1110	1466	11931	28.5	61.1	13.6	12.4	72.4	.38	63.0	532	660	666	706	641	149	83.8	78.8
C.-D.C. x C.-H.-F. ^{1/}	Ns.2746	11894	27.2	60.7	13.4	12.6	72.7	.43	65.0	520	677	632	688	629	150	76.3	76.3
C.-D.C. x C.-H.-F. ^{1/}	Ns.2744	11941	29.6	59.4	13.0	12.0	71.1	.38	65.5	523	660	629	677	622	152	83.8	78.8
Average			26.3	59.0	13.5	12.6	71.6	.41	64.1	572	714	727	760	693	150	84.0	82.9
Range			8.1	4.3	1.8	1.8	4.2	.13	6.0	145	112	212	167	157	.6	12.5	12.5

Standard error = 16 cc.

^{1/} Ceres-Double Cross x Ceres-Hope-Florence.

Table 6. - Milling and baking results obtained on some of the Hard Red spring wheats grown in plots at the 4 North Dakota stations in 1939¹

Variety or cross	Nursery number	C.I. number	Acre yield	Test weight	Protein content		Flour		Water absorption, average	Baking method and volume of loaf					Weight of loaf ave- rage	Crumb color ave- rage	Grain texture ave- rage
					Wheat	Flour	Yield	Ash		No.1	No.2	No.3	No.6	Ave- rage			
			(Bu.)	(Lbs.)	(Pct.)	(Pct.)	(Pct.)	(Pct.)	(Pct.)	(Cc)	(Cc)	(Cc)	(Cc)	(Cc)	(Grams)	(Score)	(Score)
Thatcher	-----	10003	20.5	58.0	15.0	14.7	70.3	.46	63.0	663	801	900	905	817	148	87.5	86.3
Pilot-13	1098-13	11945	20.6	58.0	13.8	13.3	69.3	.42	65.0	641	807	824	821	773	149	87.5	88.8
Carleeds	-----	11801	18.8	56.5	14.1	13.2	72.6	.46	63.0	620	749	838	841	762	148	88.8	90.0
Pilot. (B)	1098-B	11428	20.2	57.6	14.2	13.5	69.6	.45	63.0	614	775	809	844	761	148	85.0	88.8
Rival	Ns.2634	11708	19.4	58.1	14.1	13.3	72.1	.48	65.0	614	761	814	844	758	149	83.7	83.8
H-44 x Ceres	1344	11883	20.4	59.0	13.7	12.6	69.9	.55	69.0	614	752	764	809	735	153	73.8	80.0
Vesta	Ns.2592	11712	19.9	59.3	14.2	13.6	72.6	.47	67.0	608	744	746	770	717	153	82.5	83.8
Mercury	Ns.2740	11872	19.8	58.0	13.7	13.0	72.5	.53	67.0	570	708	781	792	713	153	81.3	82.5
Merit	1348	11870	20.6	57.4	13.8	13.4	70.2	.48	69.0	553	703	764	798	705	156	77.5	78.8
C.-D.C. x C.-H.-F. ²	Ns.2742	11939	21.9	60.7	13.9	13.2	71.4	.45	66.0	584	718	746	770	705	152	87.5	85.0
C.-D.C. x C.-H.-F. ²	Ns.2746	11894	21.3	59.6	13.9	13.3	73.2	.51	66.0	576	694	732	761	691	152	81.3	80.0
Premier	Ns.2772	11940	21.1	60.4	13.0	12.9	71.2	.48	69.0	541	691	726	729	672	155	80.0	80.0
Average			20.4	58.6	14.0	13.3	71.2	.48	65.9	600	742	787	807	734	151	83.0	84.0
Range			3.1	4.2	2.0	2.1	2.1	.11	6.0	122	116	174	176	145	8	15.0	11.2

Standard error = 13 cc.

¹/ Composite of 1 pound from each of the Fargo, Langdon, Mandan, and Dickinson stations.

²/ Ceres-Double Cross x Ceres-Hope-Florence.

Table 7. - Milling and baking results obtained on some of the Hard Red spring wheats grown in plots at the 4 Minnesota stations in 1939^{1/}

Variety or cross	Nursery number	C.I. number	Acre yield	Test weight	Protein content		Flour		Water absorp- tion, average	Baking method and volume of loaf					Weight of loaf ave- rage	Crumb color ave- rage	Grain texture ave- rage
					Wheat	Flour	Yield	Ash		No.1	No.2	No.3	No.6	Ave- rage			
			(Bu.)	(Lbs.)	(Pct.)	(Pct.)	(Pct.)	(Pct.)	(Pct.)	(Cc)	(Cc)	(Cc)	(Cc)	(Cc)	(Grams)	(Score)	(Score)
Thatcher	----	10003	15.9	56.9	15.9	15.7	71.2	.53	65.0	743	835	957	939	869	146	90.0	91.3
H-44 x Roward	R.L.1097	11868	16.5	58.1	16.4	15.8	69.1	.63	61.0	764	850	925	920	865	146	93.8	90.0
Regent	R.L.975.1	11887	15.8	54.6	16.5	16.1	68.5	.65	63.0	675	811	942	960	847	147	82.5	86.3
H-44 x Thatcher, 2680	II-29-61	11791	18.1	55.8	16.2	15.4	69.7	.54	63.0	726	827	897	879	832	146	87.5	90.0
Carleeds	----	11801	14.5	55.0	14.9	14.1	73.1	.60	61.0	697	812	876	914	825	146	91.3	91.3
Mercury	Ns.2740	11872	20.6	57.6	15.6	14.4	70.7	.65	69.0	654	809	882	911	814	154	90.0	87.5
Rival	Ns.2634	11708	19.8	58.2	14.7	13.9	73.9	.57	67.0	709	783	868	894	814	151	86.3	86.3
Pilot (B)	1098-B	11428	19.2	57.6	14.7	13.7	71.3	.51	63.0	674	821	876	871	811	148	87.5	87.5
H-44 x Thatcher, 2831	II-29-52	11890	17.6	54.8	15.6	14.5	71.2	.60	63.0	652	800	887	847	797	148	85.0	85.0
H-44 x Double Cross	II-28-27	11892	21.7	56.3	15.4	14.6	70.3	.54	63.0	688	787	859	852	797	147	83.8	83.8
Newmarq (Great Northern)	----	12028	15.4	55.5	15.6	15.1	71.7	.62	63.0	608	761	833	917	792	150	83.8	85.0
Great Northern	Br. 123	12027	16.4	56.3	15.6	14.5	72.6	.64	63.0	629	778	865	888	790	149	86.3	87.5
Coronation	R.L.729	11475	18.6	55.8	15.5	14.7	70.6	.64	63.0	632	780	853	873	785	149	80.0	85.0
Merit	1348	11870	18.7	55.4	15.6	14.3	69.4	.58	68.0	617	767	865	859	777	154	82.5	85.0
Premier	Ns.2772	11940	18.9	58.9	15.1	14.3	75.8	.53	65.0	668	729	865	826	772	151	86.3	85.0
Vespa	Ns.2592	11712	17.7	57.1	15.3	14.3	73.0	.55	67.0	602	755	818	821	749	153	88.8	86.3
Average			17.8	56.5	15.5	14.7	71.4	.59	64.2	671	794	882	886	808	149	86.0	87.1
Range			7.2	4.3	1.8	2.4	7.3	.14	8.0	162	121	139	139	120	8	20.0	7.5
Standard error = 17 cc.																	

^{1/} Composite of 1 pound from each of the St. Paul, Waseca, Morris, and Crookston stations.

Table 8. - Milling and baking results obtained on some of the Hard Red spring wheat varieties grown in plots at Brookings, S. Dak., in 1939

Variety or cross	Nursery number	C.I. number	Acre yield	Test weight	Protein content		Flour		Water absorption, average	Baking method and volume of loaf					Weight of loaf average	Crumb color average	Grain texture average
					Wheat	Flour	Yield	Ash		No.1	No.2	No.3	No.5	Average			
			(Bu.)	(Lbs.)	(Pct.)	(Pct.)	(Pct.)	(Pct.)	(Pct.)	(Cc)	(Cc)	(Cc)	(Cc)	(Cc)	(Grams)	(Score)	(Score)
Rival	Ns.2634	11708	32.2	56.8	15.7	14.9	71.4	.43	64.0	853	968	974	963	940	146	91.3	90.0
Pilot (B)	1098-B	11428	31.9	57.1	15.7	15.2	71.1	.52	66.0	812	910	951	985	915	149	91.3	88.8
Thatchor	—	10003	30.9	58.1	16.0	14.8	69.5	.52	63.0	792	928	960	962	911	146	91.3	93.8
Merit	1348	11870	31.3	57.4	16.1	15.3	71.1	.43	71.0	724	876	951	1006	889	153	93.8	91.3
Hope-Reliance x Reward S.D.1465	12033		23.1	60.7	15.8	14.8	70.0	.45	65.0	729	838	917	1006	873	148	88.8	87.5
Hope x Ceres S.D.1463	11897		30.3	58.3	15.6	14.5	71.6	.50	63.0	712	838	934	976	865	147	91.3	83.8
Hope-Reliance x Reward S.D.1464	12009		19.7	59.6	16.0	14.8	70.3	.42	63.0	715	853	868	885	830	147	90.0	90.0
Premier	Ns.2772	11940	30.2	59.7	15.9	15.0	71.5	.43	70.0	752	789	818	850	802	154	92.5	88.8
Average			28.7	58.5	15.9	14.9	70.8	.46	65.6	761	875	922	954	878	149	90.0	89.3
Range			12.5	3.9	0.5	0.8	2.1	.10	8.0	142	130	106	121	110	18	12.5	10.0
Standard error = 25 cc.																	

Table 9. - Yields and milling, baking, and chemical properties on the uniform varieties of spring wheats grown in plot experiments from (1) eastern, (2) western, and (3) average of eastern and western composites, of the 1939 crop

Variety	C.I.no.	Acre yield	Test weight	Protein content		Flour		Carotenoid content	Water absorption ^{2/}	Baking methods and loaf volumes					Weight of loaf ^{2/}	Crumb ^{2/} color	Grain ^{2/} texture
				Wheat	Flour	Yield	Ash			No.1	No. 2	No.3	No. 6	Average			
		(Bu.)	(Lbs.)	(Pct.)	(Pct.)	(Pct.)	(Pct.)	(P.p.n.)	(Pct.)	(Cc)	(Cc)	(Cc)	(Cc)	(Cc)	(Grams)	(Score)	(Score)
EASTERN COMPOSITE^{3/}																	
Pilot	11428	19.2	56.7	15.9	15.4	70.3	.57	2.01	66.0	821	896	982	1012	928	149	85.0	91.3
Thatcher	10003	17.6	56.0	16.4	16.0	70.7	.54	2.13	68.0	792	883	991	1012	921	151	85.0	85.0
Marquis	3641	13.8	55.0	16.2	15.2	69.3	.56	2.13	65.5	764	832	914	950	878	150	89.3	89.3
Rival	11708	18.9	56.8	15.8	15.1	70.8	.61	1.79	67.0	760	835	933	959	872	149	91.3	91.3
Renown	11947	15.7	57.1	17.1	16.6	69.6	.59	1.79	66.5	727	818	942	994	870	150	89.3	89.3
Ceres	6900	17.1	56.8	16.0	15.4	70.6	.60	2.01	67.0	749	865	911	954	870	151	87.5	89.3
Merit	11870	18.8	55.4	16.3	15.4	70.3	.61	1.68	69.5	694	706	905	991	844	155	82.5	82.5
Premier	11940	19.0	53.7	15.8	15.1	72.5	.61	1.34	67.0	683	795	874	960	828	152	93.8	91.3
Average		17.5	56.6	16.2	15.5	70.5	.59	1.86	67.1	749	846	932	979	876	151	88.0	88.7
Range		5.3	3.7	1.3	1.5	3.2	.07	0.79	4.0	138	110	117	62	100	6	11.3	8.8
Standard error of the difference between any two varieties = 17 cc.																	
WESTERN COMPOSITE^{4/}																	
Thatcher	10003	26.2	56.0	16.1	15.7	70.6	.52	2.13	66.0	755	856	920	939	868	151	85.0	86.3
Pilot	11428	24.6	56.2	15.3	14.4	70.4	.52	2.13	66.0	729	841	908	832	840	151	85.0	86.3
Renown	11947	22.7	57.7	15.4	14.9	70.8	.54	2.24	67.0	691	778	891	942	826	151	82.5	89.3
Marquis	3641	23.1	57.3	15.0	14.4	70.5	.52	1.79	63.0	703	824	856	868	813	149	87.5	90.0
Ceres	6900	25.5	58.8	15.3	14.6	71.0	.50	2.01	65.0	706	804	847	862	805	153	81.3	89.3
Merit	11870	25.1	55.8	15.7	14.6	70.0	.55	1.79	68.0	640	767	841	876	781	153	82.5	82.5
Rival	11708	23.5	56.8	14.9	14.0	72.6	.58	1.90	65.0	677	775	818	818	772	151	83.8	90.0
Premier	11940	24.9	58.3	14.6	13.8	71.5	.54	1.68	67.0	596	735	781	798	728	154	81.3	83.8
Average		24.5	57.1	15.3	14.6	70.9	.53	1.96	65.9	687	798	858	873	804	152	83.6	87.2
Range		3.1	3.0	1.5	1.9	2.2	.08	0.56	6.0	159	121	139	144	140	5	6.2	7.5
Standard error of the difference between any two varieties = 15 cc.																	
AVERAGE OF EASTERN AND WESTERN COMPOSITE																	
Thatcher	10003	21.6	56.0	16.3	15.9	70.7	.53	2.13	67.0	774	872	956	976	895	151	85.0	85.7
Pilot	11428	21.7	56.5	15.6	14.9	70.4	.55	2.07	66.0	775	869	945	947	884	150	85.0	88.8
Renown	11947	19.0	57.4	16.3	15.8	70.2	.57	2.02	66.0	709	798	917	968	848	151	85.9	89.3
Marquis	3641	18.2	56.2	15.6	14.8	69.9	.54	1.96	64.3	734	853	885	909	846	150	88.4	89.7
Ceres	6900	21.1	57.3	15.7	15.0	70.8	.55	2.01	66.0	728	835	879	908	838	152	84.4	89.3
Rival	11708	21.1	56.8	15.4	14.6	71.7	.60	1.85	66.0	719	805	876	889	822	150	87.6	90.7
Merit	11870	21.8	55.6	16.0	15.0	70.2	.58	1.74	68.8	667	777	873	934	813	154	82.5	82.5
Premier	11940	21.3	58.5	15.2	14.5	72.0	.58	1.51	67.0	640	765	828	879	778	152	87.6	87.6
Average		20.8	56.9	15.8	15.1	70.7	.56	1.91	66.5	718	822	895	926	841	151	85.8	88.0
Range		3.6	2.5	1.1	1.4	2.1	.07	0.62	4.5	135	107	128	97	117	4	5.9	8.2

Standard error of the difference between any two varieties = 15 cc.

^{1/} Average yields for those stations included in the composites.

^{2/} Average for 4 baking methods.

^{3/} One pound each from the St. Paul, Waseca, Morris, Crookston, Fargo, Langdon, Brookings, Highmore, and Lincoln stations.

^{4/} One pound each from the Mandan, Dickinson, Havre, Moccasin, Bozeman, Sheridan, North Platte, and Alliance stations.

Table 10. -- Average milling and baking results obtained on five Hard Red spring wheat varieties from 9 milling and baking tests, Crop of 1939

Variety	Nursery number	C.I. number	Test weight	Protein content		Flour		Water absorption, average	Baking method and volume of loaf					Weight of loaf average	Crumb color average	Grain texture average
				Wheat	Flour	Yield	Ash		No.1	No.2	No.3	No.6	Average			
			(Lbs.)	(Pct.)	(Pct.)	(Pct.)	(Pct.)	(Pct.)	(Cc)	(Cc)	(Cc)	(Cc)	(Cc)	(Grams)	(Score)	(Score)
Thatcher	---	10003	57.3	15.4	14.8	70.6	.50	64.6	717	823	911	920	844	149	86.9	88.1
Pilot (B)	1098-B	11428	57.3	14.8	14.0	70.4	.50	64.0	682	809	871	890	812	149	85.8	88.1
Rival	Ns.2634	11708	57.7	14.5	13.8	72.5	.52	64.9	671	786	841	867	792	149	85.3	87.2
Merit	1348	11870	56.8	14.7	14.0	70.9	.52	68.5	612	745	823	858	759	154	81.8	82.5
Premier	Ns.2772	11940	59.7	14.3	13.7	72.6	.51	68.2	608	720	782	808	730	154	83.9	83.4
Average			57.8	14.7	14.1	71.4	.51	66.0	657	777	846	869	787	151	84.8	85.9
Range			2.9	1.1	1.1	2.2	.02	4.5	109	102	129	112	114	5	5.1	5.6

Average of results from eastern section, western section, 4 North Dakota, and 4 Minnesota station composites, together with Fargo, Langdon, Mandan, and Dickinson, N. Dak., and Brookings, S. Dak., station samples.

Table 11. - Milling and baking results obtained on some new strains of the Hard Red spring wheats increased from Arizona seed, sown late at Bozeman, Mont., in 1939

Variety or cross	Nursery number	Test weight	Protein content		Flour			Water absorption, average	Baking method and volume of loaf					Weight of loaf average	Crumb color average	Grain of crumb average
			Wheat	Flour	Yield	Ash	Carotenoid content		No.1	No.2	No.3	No.6	Average			
		(Lbs.)	(Pct.)	(Pct.)	(Pct.)	(Pct.)	(P.p.m.)	(Pct.)	(Cc)	(Cc)	(Cc)	(Cc)	(Cc)	(Grams)	(Score)	(Score)
Comet-1121 x Cores-Hope-Florence	1523	61.6	14.3	12.6	75.4	.39	1.45	63.0	660	795	829	853	784	148	83.8	90.0
Merit-3	1348-3	59.7	15.0	14.3	72.4	.49	1.79	68.0	596	733	856	888	768	154	73.8	75.0
Thatcher	----	60.9	13.4	12.6	73.0	.48	1.68	63.0	638	761	847	772	755	149	81.3	86.3
Comet-1110 x H-44-Ceres	1513	59.3	14.7	14.3	73.1	.46	1.79	66.0	593	755	818	798	741	153	80.0	85.0
Reliance-Hope x Comet-1121	1517	61.3	14.1	13.2	73.2	.43	1.68	63.0	593	752	792	770	727	150	76.3	83.8
Reliance-Hope x Comet-1121	1516	60.2	14.6	14.1	73.8	.47	1.90	63.0	576	758	812	726	718	150	77.5	83.8
Comet-1098 x Comet-1121	1529	61.0	13.7	12.7	74.2	.38	1.90	66.0	611	719	740	784	714	152	75.0	80.0
Reliance-Hope x H-44-Ceres	1525	61.5	13.7	13.5	73.1	.40	1.79	63.0	581	712	753	795	712	150	76.3	80.0
Reliance-Reward x H-44-Ceres	1528	61.7	13.2	12.7	74.5	.42	1.68	67.0	576	712	772	778	710	152	77.5	81.3
Reliance-Hope x Comet-1121	1521	59.0	14.2	13.4	72.9	.30	1.56	61.0	599	715	746	749	702	148	81.3	81.3
Comet-1110 x H-44-Ceres	1512	60.8	15.1	14.3	73.2	.45	2.01	65.0	544	700	741	761	687	151	73.8	78.8
Reliance-Hope x Comet-1121	1520	61.1	13.2	12.7	73.1	.33	1.68	61.0	565	712	732	718	682	143	78.0	83.8
Average		60.7	14.1	13.4	73.5	.42	1.74	64.1	594	735	787	783	725	150	78.0	82.4
Range		2.7	1.9	2.2	3.0	.19	.56	7.0	116	95	124	170	102	6	10.0	15.0

Table 12. - Milling and baking results obtained on some Hard Red spring wheats grown in 9-row nursery tests at Mandan, N. Dak., in 1939

Variety or cross	Nursery number	Test weight	Protein content		Flour			Water absorption, average	Baking method and volume of loaf					Weight of loaf average	Crumb color average	Grain of crumb average
			Wheat	Flour	Yield	Ash	Carotenoid content		No.1	No.2	No.3	No.6	Average			
		(Lbs.)	(Pct.)	(Pct.)	(Pct.)	(Pct.)	(P.p.m.)	(Pct.)	(Cc)	(Cc)	(Cc)	(Cc)	(Cc)	(Grams)	(Score)	(Score)
Pilot-13	1098-13	59.8	14.9	14.2	68.2	.49	1.90	63.0	769	856	815	876	829	147	90.0	88.8
H-44 x Ceres	1348-15	59.6	14.7	14.2	69.1	.57	1.34	69.0	635	798	764	809	752	153	81.3	85.0
Hope x Reward	1526	62.6	15.4	14.4	70.0	.50	1.68	63.0	660	793	764	753	743	147	77.5	86.3
H-44 x Ceres	1342-24	62.4	13.8	13.1	69.4	.55	2.13	67.0	579	761	712	729	695	154	72.5	76.3
Average		61.1	14.7	14.0	69.2	.53	1.76	65.5	661	802	764	792	755	150	80.3	84.1
Range		3.0	1.6	1.3	1.8	.08	0.79	6.0	190	95	103	147	134	7	17.5	12.5

Table 13. - Milling and baking results on the wheats of the Uniform Regional Nursery for (1) eastern, (2) western, and (3) average of eastern and western composites, of the 1939 crop

Variety or cross	Nursery number	C.I. no.	Acro yield 1/	Test weight	Protein content		Flour		Carotenoid content (P.p.m.)	Water absorption, average	Baking method and volume of loaf					Weight of loaf ave- rage	Crumb color ave- rage	Grain texture ave- rage
					Wheat	Flour	Yield	Ash			No.1	No.2	No.3	No.6	Ave- rage			
			(Bu.)	(Lbs.)	(Pct.)	(Pct.)	(Pct.)	(Pct.)		(Pct.)	(Cc)	(Cc)	(Cc)	(Cc)	(Cc)	(Grams)	(Score)	(Score)
EASTERN COMPOSITE^{2/}																		
Ceres-D.C. x C.-H.-F. ^{3/}	Ns. 2809	12007	21.8	58.8	16.9	16.4	70.1	.49	1.22	69.0	803	902	936	942	896	151	97.5	93.8
Reliance x Hope	1139-22	11934	21.1	58.0	16.3	15.3	70.6	.55	2.13	64.0	786	879	923	942	833	147	88.8	88.8
Pilot-13	1098-13	11945	24.8	58.0	15.2	14.5	69.8	.52	1.79	65.0	809	888	847	891	859	143	95.0	92.5
Thatcher	-----	10003	19.7	58.0	15.7	15.1	71.2	.52	2.13	67.0	764	795	902	954	854	150	86.3	95.0
H-44 x Thatcher	II-29-60	11898	19.5	58.6	15.3	15.3	71.5	.56	1.90	65.0	772	806	877	923	845	150	83.8	93.8
C.-D.C. x C.-H.-F.^{3/}																		
Regent	R.L. 975.1	11369	19.6	56.5	16.8	16.5	69.5	.58	1.90	67.0	700	780	905	970	839	151	83.8	88.8
H-44 x Thatcher	II-29-61	11791	21.3	57.6	16.0	15.6	71.9	.52	2.01	66.0	737	792	873	919	830	151	85.0	91.3
H-44 x Marquis	R.L. 704.1	11887	20.1	57.1	15.2	15.0	70.5	.57	2.01	66.0	710	804	879	914	827	151	86.3	88.8
H-44 x Marquis	Sel.1517	11731	20.1	59.3	15.7	14.7	71.2	.54	1.90	65.0	732	806	862	902	826	149	76.3	88.8
Hope x Ceres	S.D.1463	11897	22.2	58.0	15.3	14.9	71.0	.55	1.79	66.5	706	769	882	942	825	150	88.8	85.0
H-44 x Thatcher	II-29-52	11890	22.5	56.8	16.0	15.4	71.4	.56	2.13	66.0	719	803	871	905	825	151	81.3	88.8
Comet-1110 x H-44-Ceres	1443	11949	19.7	56.2	15.6	14.6	69.7	.56	2.58	66.5	740	847	833	859	821	151	73.8	86.3
C.-D.C. x C.-H.-F. ^{3/}	Ns. 2744	11941	23.9	59.1	15.2	14.4	72.2	.54	1.79	70.0	743	862	815	853	818	154	87.5	91.3
H-44 x Double Cross	II-23-27	11892	22.5	58.4	15.6	14.9	71.5	.51	2.69	63.0	740	806	826	873	811	148	73.8	87.5
Marquis	-----	3641	18.4	58.1	14.4	14.1	68.8	.53	1.79	63.0	735	804	847	850	809	148	90.0	93.8
C.-D.C. x C.-H.-F. ^{3/}	Ns. 2797	12005	23.6	56.8	15.3	14.3	72.6	.50	2.01	67.0	721	798	823	847	797	152	88.8	91.3
Comet x N. No. 1110	1466	11931	21.4	60.1	15.4	14.9	72.4	.53	1.79	64.0	719	775	809	871	794	148	87.5	92.5
Reliance-Hope x Reward	S.D.1464	12009	20.1	61.8	15.9	14.8	70.7	.52	2.24	63.0	727	821	806	815	792	148	86.3	83.8
H-44-Ceres x Marquis	1464	11929	19.3	56.0	15.3	14.6	71.5	.60	2.35	63.0	648	732	859	911	788	149	76.3	81.3
H-44 x Ceres	1349	11882	21.4	57.4	15.6	15.2	70.1	.63	1.56	70.0	641	743	833	902	780	156	85.0	82.5
Comet x Pilot	1465	11930	22.5	58.1	14.7	13.9	70.0	.50	2.24	66.0	695	781	792	820	772	150	78.8	88.8
N. No. 1131 x Pilot	1441	11943	21.3	59.3	15.1	14.5	70.0	.51	2.01	66.0	719	841	769	758	772	150	82.5	86.3
H-44 x Thatcher	II-28-49	11889	21.2	59.0	15.0	14.1	70.5	.49	1.56	65.5	680	801	806	781	767	151	92.5	90.0
C.-D.C. x C.-H.-F. ^{3/}	Ns. 2800	12006	22.6	56.8	15.0	14.5	71.5	.61	1.56	68.0	620	746	821	876	766	154	81.3	86.3
H-44 x Ceres	1344-B	11883	24.1	59.7	14.6	14.1	71.5	.60	2.24	69.0	660	737	758	818	743	155	77.5	86.3
Average			21.5	58.2	15.5	14.9	70.9	.54	1.94	66.0	722	806	848	881	815	150	84.9	89.2
Range			6.6	5.0	2.5	2.6	3.8	.12	1.36	7.0	189	170	178	212	153	9	23.7	13.7

Standard error of a difference between any two varieties = 25 cc.

Table 13. (Continued)

Variety or cross	Nursery number	C.I. number	Acre yield 1/	Test weight	Protein content		Flour			Water absorption, average	Baking method and volume of loaf					Weight of loaf ave- rage	Crumb color ave- rage	Grain texture ave- rage
					Wheat	Flour	Yield	Ash	Carotenoid content		No.1	No.2	No.3	No.6	Ave- rage			
			(Bu.)	(Lbs.)	(Pct.)	(Pct.)	(Pct.)	(Pct.)	(P.p.m.)	(Pct.)	(Cc)	(Cc)	(Cc)	(Cc)	(Cc)	(Grams)	(Score)	(Score)
WESTERN COMPOSITE ^{4/}																		
Thatcher	-----	10003	30.6	54.3	17.1	16.3	60.2	.53	2.24	67.5	830	948	957	1055	950	147	83.8	87.5
Pilot-13	1090-13	11945	29.5	53.8	16.7	16.3	67.2	.55	2.01	65.0	953	942	948	1041	946	146	83.8	86.3
Regent	R.L.975.1	11869	26.2	53.6	16.6	16.4	69.1	.53	2.24	65.0	736	862	932	1021	901	147	83.8	85.0
H-44 x Double Cross	II-28-27	11892	30.2	54.2	17.0	16.3	67.2	.45	3.26	66.0	787	899	908	954	887	149	80.5	86.3
Marquis	-----	3641	24.8	55.4	16.2	15.5	67.4	.59	1.68	63.0	761	900	874	931	867	146	87.5	83.8
Comet x N. No. 1110	1466	11931	25.4	57.4	15.7	15.9	67.2	.53	2.47	66.0	734	844	920	963	865	148	73.8	83.8
H-44 x Ceres	1349	11882	26.1	54.3	17.1	16.4	66.4	.65	1.68	71.0	712	841	905	982	860	154	82.5	82.5
Reliance-Hope x Reward	S.D.1464	12009	24.8	59.1	16.6	15.7	68.4	.43	2.58	67.0	740	893	844	951	857	148	80.0	85.0
H-44 x Thatcher	II-29-60	11898	27.7	55.0	16.6	15.9	68.1	.52	2.35	65.5	697	879	868	948	848	150	81.5	85.0
H-44-Ceres x Marquis	1464	11929	27.5	54.0	16.5	15.7	69.0	.49	2.47	65.0	740	841	882	914	844	148	80.0	83.8
C.-D.C. x C.-H.-F. ^{3/}	Ns. 2797	12005	30.5	54.2	15.9	15.2	68.8	.45	1.79	69.0	758	875	856	882	843	151	86.3	88.8
H-44 x Thatcher	II-29-61	11791	29.3	54.0	16.3	15.7	68.4	.51	2.24	65.5	709	844	865	940	840	150	81.5	82.5
H-44 x Marquis	R.L.704.1	11887	26.7	53.9	16.1	15.2	67.1	.54	2.24	65.0	729	850	829	931	835	149	73.8	86.3
C.-D.C. x C.-H.-F. ^{3/}	Ns. 2809	12007	26.8	55.7	16.9	16.3	68.5	.45	1.56	67.0	795	832	850	853	833	151	93.3	95.0
Hope x Ceres	S.D.1463	11897	24.7	55.0	16.2	15.1	67.3	.47	1.90	66.0	706	815	872	934	832	148	83.3	87.5
H-44 x Thatcher	II-28-52	11890	29.1	52.7	16.4	15.9	67.9	.51	2.13	66.0	700	856	862	908	832	150	77.5	83.8
Reliance x Hope	1139-22	11934	23.9	53.8	17.1	15.4	68.0	.45	2.24	65.0	778	841	844	853	829	148	86.3	86.3
Comet-1110 x H-44-Ceres	1448	11949	28.0	53.1	16.2	15.6	66.5	.53	2.92	65.5	727	838	835	914	829	150	70.0	87.5
C.-D.C. x C.-H.-F. ^{3/}	Ns. 2829	12008	30.8	57.3	16.2	15.4	69.3	.44	1.68	65.5	781	826	812	888	827	150	91.3	93.8
C.-D.C. x C.-H.-F. ^{3/}	Ns. 2800	12006	30.4	54.2	16.0	15.5	68.1	.48	1.56	70.0	691	818	862	917	822	155	78.8	86.3
H-44 x Marquis	Sel.1517	11701	26.3	56.0	16.4	14.9	66.3	.44	2.24	64.0	755	853	829	850	822	148	75.0	90.0
H-44 x Ceres	1344-B	11883	28.5	55.0	15.8	15.1	68.3	.64	2.24	70.0	691	815	856	873	809	154	72.5	80.0
N. No. 1131 x Pilot	1441	11948	25.6	55.0	16.4	15.6	65.2	.54	2.35	68.0	603	821	835	894	808	153	72.5	77.5
C.-D.C. x C.-H.-F. ^{3/}	Ns. 2744	11941	31.8	56.4	15.8	15.0	63.3	.47	2.13	66.0	703	850	812	850	804	150	83.8	85.3
Comet x Pilot	1465	11930	31.0	55.2	15.7	14.8	67.5	.39	2.47	66.0	755	865	780	798	800	148	77.5	90.0
H-44 x Thatcher	II-28-49	11889	29.3	55.2	15.1	14.6	68.2	.47	1.79	67.0	706	801	725	829	765	151	87.5	86.3
Average			27.9	54.9	16.3	15.6	67.8	.51	2.17	66.4	741	856	862	918	844	150	80.9	86.0
Range			7.9	6.0	2.0	2.2	4.1	.26	1.70	8.0	170	147	257	257	185	9	23.8	17.5

Standard error of difference between any two varieties = 24 cc.

Table 13. (Continued)

Variety or cross	Nursery number	C.I. number	Acre yield	Test weight	Protein content		Flour			Water absorption, average	Baking method and volume of loaf					Weight of loaf	Crumb color	Grain texture
					Wheat	Flour	Yield	Ash	Carotenoid content		No.1	No.2	No.3	No.6	Average			
AVERAGE OF EASTERN AND WESTERN COMPOSITES																		
Pilot-13	1098-13	11945	27.2	55.9	16.0	15.4	68.5	.54	1.90	65.0	831	915	898	966	903	147	91.9	89.4
Thatcher	-----	10003	25.2	56.2	16.4	16.0	69.7	.55	2.19	67.3	801	872	930	1005	902	149	85.1	91.3
Regent	R.L.975.1	11869	22.9	55.1	16.7	16.5	69.3	.58	2.07	66.0	719	821	944	996	870	149	83.8	86.9
C.-D.C. x C.-H.-F. ^{3/}	Ns. 2809	12007	24.3	57.3	16.9	16.4	69.3	.47	1.39	68.0	799	867	893	898	864	151	95.7	94.4
Reliance x Hope	1139-22	11934	22.5	55.9	16.7	15.4	69.3	.50	2.19	64.5	782	860	884	898	856	148	87.6	87.6
H-44 x Double Cross	II-28-27	11892	26.4	56.3	16.3	15.6	69.4	.48	2.98	64.5	764	853	867	914	849	149	71.2	86.9
H-44 x Thatcher	II-29-60	11898	23.6	56.8	16.2	15.6	69.8	.54	2.13	65.3	735	843	873	936	847	150	82.7	89.4
Marquis	-----	3641	21.6	56.8	15.3	14.8	68.1	.56	1.74	63.0	748	852	861	891	838	147	83.8	88.8
H-44 x Thatcher	II-29-61	11791	25.3	55.8	16.2	15.7	70.2	.52	2.13	65.8	723	818	869	930	835	151	83.3	86.9
C.-D.C. x C.-H.-F. ^{3/}	Ns. 2829	12008	27.9	58.9	16.0	15.1	70.2	.47	1.45	65.5	770	838	850	881	835	150	92.6	94.4
H-44 x Marquis	R.L.704.1	11897	23.4	55.5	15.7	15.1	68.8	.56	2.13	65.5	720	827	854	923	831	150	80.1	87.6
Comet x N. No. 1110	1466	11931	23.4	58.8	15.6	15.4	69.8	.53	2.13	65.0	727	810	865	917	830	148	80.7	88.2
H-44 x Thatcher	II-28-52	11890	25.8	54.8	16.2	15.7	69.7	.54	2.13	66.0	710	830	867	907	829	151	79.4	86.3
Hope x Ceres	S.D.1463	11897	23.5	56.5	15.8	15.0	69.2	.51	1.85	66.3	706	792	877	933	828	149	83.3	86.3
Comet-1110 x H-44-Ceres	1443	11949	23.9	54.7	15.9	15.1	68.1	.55	2.75	66.0	734	843	837	887	825	151	71.9	86.9
Reliance-Hope x Reward	S.D.1464	12009	22.5	60.5	16.3	15.3	69.6	.48	2.41	65.0	734	857	825	883	825	148	83.2	84.4
H-44 x Marquis	Sel.1517	11781	23.2	57.7	16.1	14.8	68.8	.49	2.07	64.5	744	830	846	876	824	149	75.7	89.4
C.-D.C. x C.-H.-F. ^{3/}	Ns. 2797	12005	27.1	55.5	15.6	14.8	70.7	.48	1.90	67.5	740	837	840	865	820	152	87.6	90.1
H-44 x Ceres	1349	11882	23.8	55.9	16.4	15.8	68.3	.64	1.62	70.5	677	792	869	942	820	155	83.8	82.5
H-44-Ceres x Marquis	1464	11929	23.4	55.0	15.9	15.2	70.3	.55	2.41	64.0	694	787	871	913	816	149	78.2	82.6
C.-D.C. x C.-H.-F. ^{3/}	Ns. 2744	11941	27.9	57.8	15.5	14.7	70.3	.51	1.96	68.0	723	856	814	852	811	152	85.7	88.8
C.-D.C. x C.-H.-F. ^{3/}	Ns. 2800	12006	26.5	55.5	15.5	15.0	69.8	.55	1.56	69.0	656	782	842	897	794	155	80.1	86.3
N. No. 1131 x Pilot	1441	11948	23.5	57.2	15.8	15.1	67.6	.53	2.18	67.0	701	831	802	826	790	152	77.5	81.9
Comet x Pilot	1465	11930	26.8	56.7	15.2	14.4	68.8	.45	2.36	66.0	725	823	786	809	786	149	78.2	89.4
H-44 x Ceres	1344-B	11883	26.3	57.4	15.2	14.6	69.9	.62	2.24	69.5	676	776	807	846	776	155	75.0	83.2
H-44 x Thatcher	II-28-49	11889	25.3	57.1	15.1	14.4	69.4	.48	1.68	66.3	693	801	766	805	766	151	80.0	88.2
Average			24.7	56.6	15.9	15.3	69.3	.53	2.06	66.2	732	831	855	900	830	150	82.9	87.6
Range			6.3	5.8	1.8	2.1	3.1	.19	1.59	7.5	175	139	178	200	137	8	24.5	12.5

Standard error of a difference between any two varieties = 20 cc.

^{1/} Average yield for those stations included in the composite.^{2/} Three-fourths pound from each of the Madison, St. Paul, Waseca, Langdon, Fargo, and Brookings stations.^{3/} Ceres-Double Cross x Ceres-Hope-Florence.^{4/} Three-fourths pound from each of the Mandan, Dickinson, Alliance, Havre, and one-half pound from the Moccasin and Bozeman stations.

Table 14. - Average of the chemical, milling, and baking properties of 12 wheat varieties, the average of comparable samples of Thatcher and the difference shown in the percentage of Thatcher, with the varieties arranged in order of percentage loaf volume

Variety	No. of samples	Test weight	Crude	Yield	Ash in	Water	Baking method and					Grain ^{2/}	Crumb ^{2/}	Average of 8 properties ^{3/}
		per bushel (dockage free of wheat flour)	protein (Percent)	of flour (Pct.)	flour (Pct.)	absorption of flour (Percent)	No. 1	No. 2	No. 3	No. 6	Average	texture (Score)	color (Score)	
		(Pounds)					(Cc)	(Cc)	(Cc)	(Cc)	(Cc)			
Pilot-13	7	57.2	14.4	69.6	.48	63.9	696	824	850	872	811	88.6	88.6	
Thatcher	7	57.3	15.4	70.5	.49	64.9	711	806	890	920	833	89.0	85.9	100.0
Percent of Thatcher		99.8	93.5	98.7	96.0	98.5	97.9	102.2	95.5	94.8	97.4	99.6	103.1	99.1
Regent	4	55.0	16.5	69.5	.59	65.0	691	814	927	972	851	85.4	82.9	
Thatcher	4	56.7	16.0	70.6	.53	65.6	772	843	937	971	880	91.3	86.6	
Percent of Thatcher		97.0	103.1	98.4	111.3	99.1	89.5	96.6	98.9	100.1	96.7	93.5	95.7	96.5
Pilot (B)	9	57.3	14.8	70.4	.50	64.0	682	809	871	890	812	88.1	85.8	
Thatcher	9	57.3	15.4	70.6	.50	64.6	717	823	911	920	844	88.1	86.9	
Percent of Thatcher		100.0	96.1	99.7	100.0	99.1	95.1	98.3	95.6	96.7	96.2	100.0	98.7	98.7
Renown (New)	3	58.3	15.5	70.7	.52	65.5	662	771	872	921	807	87.9	84.8	
Thatcher	3	57.5	15.4	70.8	.49	65.7	736	839	917	932	856	86.7	85.8	
Percent of Thatcher		101.4	100.6	99.9	106.1	99.7	89.9	91.9	95.1	98.8	94.3	101.4	98.8	98.8
Rival	9	57.7	14.5	72.5	.52	64.9	671	786	841	867	792	87.2	85.3	
Thatcher	9	57.3	15.4	70.6	.50	64.6	717	823	911	920	844	88.1	86.9	
Percent of Thatcher		100.7	94.2	102.7	104.0	100.5	93.6	95.5	92.3	94.2	93.8	99.0	98.2	98.1
Marquis	4	56.5	15.5	69.0	.55	63.6	741	853	873	900	842	89.2	88.6	
Thatcher	4	56.1	16.3	70.2	.54	67.1	787	872	943	990	898	88.5	85.0	
Percent of Thatcher		100.7	95.1	98.3	101.9	94.8	94.2	97.8	92.6	90.9	93.8	100.8	104.2	98.2
Carleeds	6	56.1	14.1	73.1	.49	63.0	626	752	819	852	762	88.2	87.9	
Thatcher	6	57.7	15.1	70.8	.48	64.1	686	789	888	895	815	88.6	86.9	
Percent of Thatcher		97.2	93.4	103.2	102.1	98.3	91.3	95.3	92.2	95.2	93.5	99.5	101.2	98.0
Ceres	3	57.2	15.6	71.1	.54	65.0	703	818	874	903	825	89.1	84.6	
Thatcher	3	55.8	16.3	70.9	.52	66.5	751	845	947	983	882	85.9	84.6	
Percent of Thatcher		102.5	95.7	100.3	103.8	97.7	93.6	96.8	92.3	91.9	93.5	103.7	100.0	98.7
Merit	8	56.8	14.7	70.9	.52	68.5	612	745	823	858	759	82.5	81.8	
Thatcher	9	57.3	15.4	70.6	.50	64.6	717	823	911	920	844	88.1	86.9	
Percent of Thatcher		99.1	95.5	100.4	104.0	106.0	85.4	90.5	90.3	93.3	89.9	93.6	94.1	96.8
Mercury	6	57.9	14.1	72.4	.55	67.7	604	724	780	815	731	83.2	84.0	
Thatcher	6	57.7	15.1	70.8	.48	64.1	636	739	838	895	815	88.6	86.9	
Percent of Thatcher		100.3	93.4	102.3	114.6	105.6	88.0	91.8	87.8	91.1	89.7	93.9	96.7	95.9
Vesta	6	58.8	14.3	72.8	.49	64.0	593	722	766	780	715	82.5	83.8	
Thatcher	6	57.7	15.1	70.8	.48	64.1	686	789	888	895	815	88.6	86.9	
Percent of Thatcher		101.9	94.7	102.8	102.1	99.8	85.4	91.5	86.3	87.2	87.7	93.1	96.4	96.8
Premier	9	59.7	14.3	72.6	.51	68.2	608	720	782	808	730	83.4	83.9	
Thatcher	9	57.3	15.4	70.6	.50	64.6	717	823	911	920	844	88.1	86.9	
Percent of Thatcher		104.2	92.9	102.8	102.0	105.6	84.8	87.5	85.8	87.8	86.5	94.7	96.5	97.7

1/ Reciprocal percentage values used in computing averages of 8 properties.

2/ Average volume color and texture for 4 methods of baking (Nos. 1, 2, 3, and 6.)

3/ The 8 properties are test weight, crude protein, flour yield, ash (reciprocal values), water absorption, and average volume, grain texture, and crumb color.

Table 15. - Relative chemical, milling, and baking values of 13 varieties of Hard Red spring wheat in percentage of Thatcher

Test Weight		Crude Protein of Wheat		Flour Yield	
Premier	104.2	Regent	103.1	Carleeds	103.2
Ceres	102.5	Renown (New)	100.6	Vesta	102.8
Vesta	101.9	Thatcher	100.0	Premier	102.8
Renown (New)	101.4	Pilot (B)	96.1	Rival	102.7
Rival	100.7	Ceres	95.7	Mercury	102.3
Marquis	100.7	Merit	95.5	Merit	100.4
Mercury	100.3	Marquis	95.1	Ceres	100.3
Pilot (B)	100.0	Vesta	94.7	Thatcher	100.0
Thatcher	100.0	Rival	94.2	Renown (New)	99.9
Pilot-13	99.8	Pilot-13	93.5	Pilot (B)	99.7
Merit	99.1	Carleeds	93.4	Pilot-13	98.7
Carleeds	97.2	Mercury	93.4	Regent	98.4
Regent	97.0	Premier	92.9	Marquis	98.3

Ash of Flour ^{1/}		Water Absorption of Flour		Loaf Volume Basic Method, No. 1	
Pilot-13	102.0	Merit	108.0	Thatcher	100.0
Thatcher	100.0	Mercury	105.6	Pilot-13	97.9
Pilot (B)	100.0	Premier	105.6	Pilot (B)	95.1
Marquis	98.1	Rival	100.5	Marquis	94.2
Premier	98.0	Thatcher	100.0	Rival	93.6
Vesta	97.9	Vesta	99.8	Ceres	93.6
Carleeds	97.9	Renown (New)	99.7	Carleeds	91.3
Ceres	96.2	Pilot (B)	99.1	Renown (New)	89.9
Merit	96.0	Regent	99.1	Regent	89.5
Rival	96.0	Pilot-13	98.5	Mercury	88.0
Renown (New)	93.9	Carleeds	98.3	Vesta	86.4
Regent	88.7	Ceres	97.7	Merit	85.4
Mercury	85.4	Marquis	94.8	Premier	84.8

Loaf Volume Commercial Method, No. 2		Loaf Volume Commercial-Bromate Method, No. 3		Loaf Volume Commercial-Bromate + Malted Wheat Flour, No. 6	
Pilot-13	102.2	Thatcher	100.0	Regent	100.1
Thatcher	100.0	Regent	98.9	Thatcher	100.0
Pilot (B)	98.3	Pilot (B)	95.6	Renown (New)	98.8
Marquis	97.8	Pilot-13	95.5	Pilot (B)	96.7
Ceres	96.8	Renown (New)	95.1	Carleeds	95.2
Regent	96.6	Marquis	92.6	Pilot-13	94.8
Rival	95.5	Rival	92.3	Rival	94.2
Carleeds	95.3	Ceres	92.3	Merit	93.3
Renown (New)	91.9	Carleeds	92.2	Ceres	91.9
Mercury	91.8	Merit	90.3	Mercury	91.1
Vesta	91.5	Mercury	87.8	Marquis	90.9
Merit	90.5	Vesta	86.3	Premier	87.8
Premier	87.5	Premier	85.8	Vesta	87.2

Loaf Volume Average of 4 methods		Grain-Texture Average of 4 methods		Crumb Color Average of 4 methods	
Thatcher	100.0	Ceres	103.7	Marquis	104.2
Pilot-13	97.4	Renown (New)	101.4	Pilot-13	103.1
Regent	96.7	Marquis	100.8	Carleeds	101.2
Pilot (B)	96.2	Pilot (B)	100.0	Ceres	100.0
Renown (New)	94.3	Thatcher	100.0	Thatcher	100.0
Rival	93.8	Pilot-13	99.6	Renown (New)	98.8
Marquis	93.8	Carleeds	99.5	Pilot (B)	98.7
Carleeds	93.5	Rival	99.0	Rival	98.2
Ceres	93.5	Premier	94.7	Mercury	96.7
Merit	89.9	Mercury	93.9	Premier	96.5
Mercury	89.7	Merit	93.6	Vesta	96.4
Vesta	87.7	Regent	93.5	Regent	95.7
Premier	86.5	Vesta	93.1	Merit	94.1

^{1/} Reciprocal percentage values used here and in computing averages for 8 properties.

SUMMARY OF THE QUALITY FACTORS FOR NAMED VARIETIES

In tables 14 and 15 are presented averages of the chemical, milling, and baking properties of 13 named varieties, together with the averages of comparable samples of Thatcher and the difference shown in percentage of Thatcher. These are the leading commercial varieties grown in the region and the most promising new hybrid strains that have recently been named, increased, or distributed. From 3 to 9 comparisons are possible for these varieties. In presenting these data it should be pointed out that the results of so few tests are not conclusive. Nine experiments have been made for the 1939 crops for 5 of the varieties, which may give a fairly reliable index of their quality, and the percentages are not only comparable with Thatcher but with each other. These data are given in table 10. The more important quality comparisons shown in the summary tables 14 and 15 will be discussed in relation to Thatcher and in the order of their average loaf volumes for the 4 methods, 1, 2, 3, and 6, compared with Thatcher as 100 percent.

THATCHER

Thatcher was developed in cooperative experiments between the Minnesota Agricultural Experiment Station and the Division of Cereal Crops and Diseases, Bureau of Plant Industry, U. S. Department of Agriculture. It is the result of a double cross (Marquis-Iumillo x Marquis-Kanred) made in 1921. The selection resulting in Thatcher was made in 1925, and since distribution in 1934, it has become extensively grown in Minnesota, North Dakota, South Dakota, and Canada. Thatcher has shown excellent milling and baking qualities and as it is rust-resistant and yields well and has become so widely grown in the spring wheat region, it is used here as the standard (100 percent) for comparison. From the 1939 results it ranks first both for loaf volume and for the average of eight properties. This was higher than it ranked in 1938 and in most of the previous years and may be due in part to lower comparative yields.

PILOT-13

Pilot-13 is a single line selection and one of the 9 lines composited for Pilot (B). The Pilot-13 strain is more resistant to leaf rust, mildew, and bunt than Pilot (B) and also has yielded more and shows somewhat better quality. It is being increased with the view to becoming the foundation stock seed of Pilot wheat. Eight comparable 1939 samples of Pilot-13 show it to exceed Thatcher in ash, loaf volume for Method No. 2, and crumb color. It averaged slightly lower than Thatcher for the other properties. A summary for eight properties show Pilot-13 to average 99.1 percent of Thatcher, ranking second among the named varieties discussed here in both average loaf volume and for all properties.

REGENT

(H-44 x Reward, R.L. 975.1, C.I. 11869) was distributed for commercial growing in Canada in the spring of 1939. Four comparable 1939 samples show Regent to exceed Thatcher in crude protein, and loaf volume for Method No. 6. It averages slightly lower than Thatcher in the other properties. It ranks third among the named varieties for average loaf volume and the 1939 summary of eight properties shows Regent to average 96.5 percent of Thatcher.

PILOT (B)

Pilot (Hope x Ceres, N. No. 1098-B, C.I. 11428) has been a uniform variety in plots at all stations for four years, and was distributed for commercial growing in North Dakota in 1939. The Pilot (B) strain was substituted for the original Pilot in plots at most stations in 1938 and at all stations in 1939. Pilot (B) is a composite of 9 single line strains. Eight comparable 1939 samples show Pilot (B) to equal Thatcher in test weight, ash, and crumb color. It averaged slightly lower than Thatcher in the other properties, ranking fourth in volume. A summary for eight properties shows Pilot (B) to average 98.7 percent of Thatcher. In 1938 the average of 8 samples was 102.3 percent of Thatcher.

RENOWN (NEW)

Renown (H-44 x Reward, R.L. 716.6, C.I. 11947) was substituted for the original Renown, C.I. 11635, in 1939. The original Renown was distributed in Manitoba, Canada, in 1937, and has been sparingly grown in the United States. This (new) single line strain was distributed in 1939. Three comparable 1939 samples show Renown (New) to exceed Thatcher in test weight, crude protein, and grain-texture but to average slightly lower than Thatcher in the other properties. It ranks fifth among the varieties in average loaf volume. A summary of eight properties shows Renown (New) to average 98.8 percent of Thatcher.

RIVAL

Rival (Ceres x Hope-Florence, Ns. 2634, C.I. 11708) was a uniform variety in plots in 1938 and was also distributed for commercial growing in North Dakota in the spring of 1939. Nine comparable 1939 samples of Rival and Thatcher show Rival has exceeded Thatcher in test weight, flour yield, and water absorption. It ranks sixth in average loaf volume for the year and a summary of 8 properties shows that Rival averaged 98.1 percent of Thatcher. For 1938, the average of eight samples was 103.2 percent of Thatcher.

MARQUIS

Marquis is the old standard hard red spring wheat and was the most widely grown variety from 1919 to 1934. Four comparable 1939 samples show that Marquis exceeded Thatcher in test weight, grain texture, and crumb color. It ranks seventh in average loaf volume and scored 98.2 percent of Thatcher for all properties. In 1938 an average of two samples showed Marquis to average 97.6 percent of Thatcher.

CERES

Ceres has been an important commercial variety since its distribution in 1925. From 1935 to 1938 it was the most widely grown variety. Three comparable 1939 samples show Ceres to exceed Thatcher in test weight, flour yield, and grain texture. It ranked eighth in loaf volume and scored 98.7 percent of Thatcher for all properties whereas in 1938 it averaged 99.4 percent of Thatcher.

CARLEEDS (NORDHAUGEN)

Carleeds was developed by Carl Nordhaugen of Leeds, North Dakota, and distributed in 1936. Six comparable 1939 samples show it to exceed Thatcher in flour yield and crumb color. It averaged lower in the other properties ranking ninth in volume among the named varieties and scored 98.0 percent of Thatcher for all properties. It is a somewhat softer wheat than the other varieties.

MERIT

Merit (H-44 x Ceres, N.No. 1348, C.I. 11870) was made a uniform variety in 1939 and is being increased by the Division of Cereal Crops and Diseases and the North Dakota and Montana stations. Nine comparable 1939 samples show Merit to exceed Thatcher in flour yield and water absorption. It averaged lower than Thatcher in the other properties and ranked tenth among the 13 named varieties for average loaf volume. A summary of eight properties shows Merit to average 96.8 percent of Thatcher in 1939 whereas in 1938 it averaged 100.1 percent of Thatcher.

MERCURY

Mercury (Ceres x Hope-Florence, Ns. 2740, C. I. 11872) is being increased by the North Dakota station. Six comparable 1939 samples show Mercury to exceed Thatcher in test weight, flour yield, and water absorption. It ranked eleventh in average loaf volume and the summary for eight properties shows Mercury to average 95.9 percent of Thatcher.

VESTA

Vesta (Ceres x Hope-Florence, No. 2592, C.I. 11712) is being increased by the North Dakota station. Six 1939 comparable samples show Vesta to exceed Thatcher in test weight and yield of flour. It averaged lower for the other properties and ranked twelfth in volume. The 1939 summary of the eight properties shows Vesta to average 96.8 percent of Thatcher.

PREMIER

Premier (Ceres-Double Cross x Ceres-Hope-Florence, No. 2772, C.I. 11940) was made a uniform variety in 1939 and is being increased by the North Dakota station. Nine comparable 1939 samples show that it exceeds Thatcher in test weight, flour yield, and water absorption. It ranked lowest in average loaf volume but the summary of 8 properties shows that it averages 97.7 percent of Thatcher.
